

Jet Propulsion Laboratory, California Institute of Technology

# White Paper: Lessons Learned Are Indeed Used by NASA Projects

## A Facilitated Discussion by the NASA KM Community

NASA Knowledge Community Meeting

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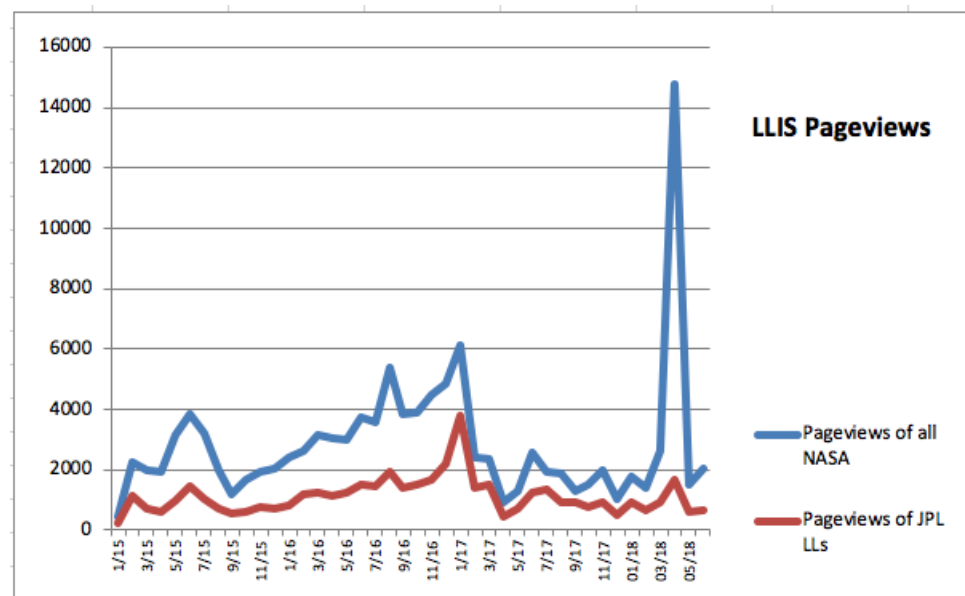
August 1, 2018

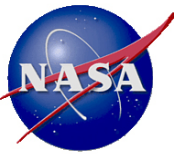


# Agency Lessons Learned Program

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- NPD 7120.6: “NASA CKO shall... promote utilization and implementation of lessons learned”
- JPL has a mature lessons learned process
  - LLC has met weekly since 1984
  - Lessons are infused into our training & practices
  - Projects are required to contribute/apply lessons learned





# Are Lessons Learned Used by Projects?

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- NASA lessons learned are not being applied by NASA projects, says the:
  - 2002 General Accounting Office report
  - 2012 NASA Office of the Inspector General audit report
- CAIB Report (Vol 1, p. 189) says:
  - “Personnel familiar with the [LLIS] indicate that design engineers and mission assurance personnel use it only on an ad hoc basis, thereby limiting its utility.”

# Usage in JPL Reqs & in Practice



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- Project review of lessons learned is a formal JPL gate product deliverable (i.e., for transition to Phases B, C, D, and E). Lesson learning is also in Flight Project Practices
  - JPL has 33 major projects in ops and 23 in development

## Examples of Project Usage

- **KSC Orion/SLS Flight Test EM-1.** When KSC engineers were performing pre-EM-1 system reviews in April<sup>1</sup>, LLIS monthly pageviews rose from <2000 to 14,803.
  - April webstats included 399 pageviews of #14901, “*Launch Site Support Services for External Stakeholders.*”
  - Also, KSC had a very high number of visitors for the April SpaceX mission, and there was an Engineering Support Contract submission at that time<sup>2</sup>

<sup>1,2</sup> Michael Bell, KSC CKO, 6/15/18, with permission. (Please note that the attribution to pre-EM-1 reviews and to other KSC events is speculative.)

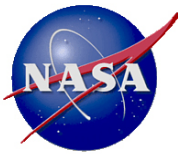
# Additional Examples of Project Usage



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- JPL grants projects wide latitude on their approach to lesson learning:
  - **JPL Mars Exploration Rover (2003 launch).** Dep MA Manager reviewed 364 JPL and GSFC LLs in the LLIS and prepared a compliance plan for each recommendation.
    - e.g., 3-D modeling for GSFC thruster plume impingement
    - He then updated the plans at various project phases
  - **JPL Kepler (2009 launch).** MA manager personally reviewed the lessons learned in the LLIS (>1000), and then asked the system subcontractor to independently repeat the exercise.

# Additional Examples of Project Usage



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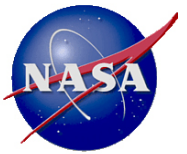
- **JPL Juno (2011 launch).** Project manager elected to:
  1. Closely follow JPL command media into which the LLs have been *infused* (e.g., Design Principles, Flight Project Practices, design/test guidelines)
  2. Focus on the LLs written on Juno-heritage missions.  
(See 9/16 NASA CKO News article by Rick Nybakken)

# Institutional Strategies (Not Project-Specific)

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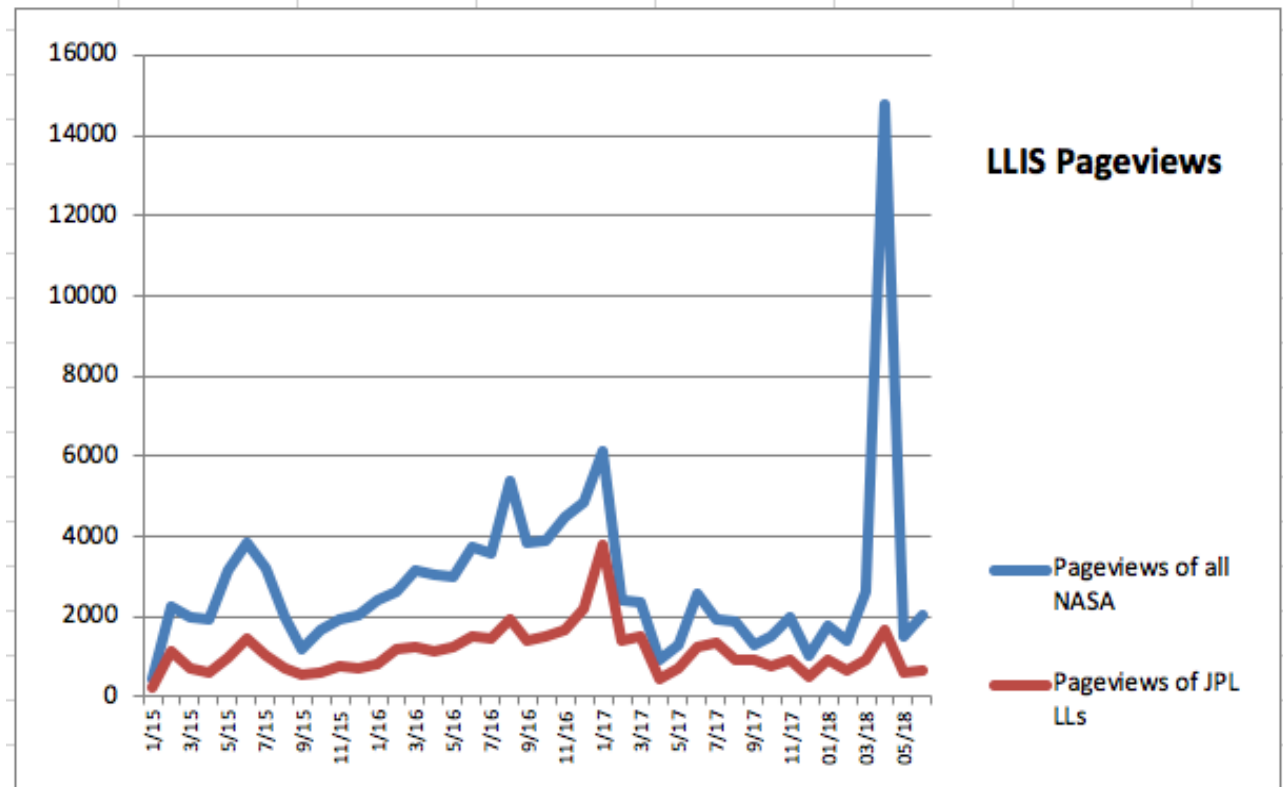
- If a center-wide process flaw is fixed, then it may be less urgent for projects to read the lesson learned?
  - Fix of the 1978 Voyager 1 flight software anomaly led to the NASA practice of IV&V (JPL D-576, February 1983)
- The NASA OIG audit states, “NASA’s **project managers** do not routinely use LLIS...” (p. ii)
  - Yet one PM-related LL in the LLIS has been viewed 2,920 times over the last five years-- #1956, “*100+ Lessons Learned for Project Managers*,” shares the observations of Jerry Madden, a former GSFC Associate Director of Flight Projects, on the art of NASA project management.
  - Did I say it has been viewed 2,920 times?! #1956 has also been incorporated into Caltech’s PMI® course for certifying project managers

# So How Much Usage Will Validate LLs?



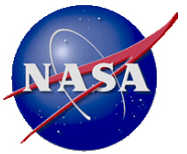
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- LLIS as a “data morgue”?



- Median usage is 2326 pageviews/mo over the past 3.5 years
- But only a single pageview may save a mission!

# Lessons Learned Use Case



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## Mars 2020 Project Learns from MSL's Actuator Woes

- Actuator issues (mainly) led to expensive 2-yr launch delay for Mars Science Laboratory (MSL) (LL #11501)
- The M2020 project is determined to avoid both the MSL woes and the residual risk of actuator failure.
- So M2020 system devel process is diverging from MSL's in some key aspects that directly correspond to LL #11501
  - Much effort devoted to understanding the MSL LL
  - Pre-Phase A focus on evaluating industry capabilities
  - Use of heritage actuators for high heritage mechanisms
  - Not relying on single supplier (& fully engaging their VPs)
  - Establishment of an integrated actuator/controller team, etc.

# Summary



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1. JPL (and NASA) has long been committed to supporting lesson learning, devoting substantial resources to it
2. JPL command media requires all JPL projects to contribute to the LLIS and to apply lessons learned
  - the *infusion* process backstops actual review of the LLIS
3. JPL projects employ a flexible approach to assessing lessons learned relevance
4. The NASA Centers are quite innovative in pioneering new approaches to lessons learning (e.g., Pause & Learn)
5. The LLIS gets used. Yes it does
6. The M2020 use case is an example of project lessons learning to mitigate risk & deter another launch delay